Preliminary Environmental Assessment

For
Ben Lomond Wind Farm

Prepared for
Allco Wind Energy Management Pty Ltd
Level 20 Gateway
1 Macquarie Place
Sydney NSW 2000

Job Reference 24861 - January 2008

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PROJECT: PRELIMINARY ENVIRONMENTAL ASSESSMENT – BEN LOMOND WIND FARM	
CLIENT:	ALLCO WIND ENERGY MANAGEMENT PTY LTD
OUR REF	24861
DATE:	JANUARY 2008
APPROVED BY:	STEVE MCCALL
SIGNATURE:	
CHECKED BY:	TOBY LAMBERT
SIGNATURE:	

CONTENTS

1 INTRODUCTION

RPS Harper Somers O'Sullivan acts on behalf of Allco Wind Energy Management Pty Ltd (Allco Wind Energy) in preparing this Preliminary Environmental Assessment for Part 3A project in reference to a wind farm proposal for Ben Lomond, NSW. Under State Environmental Planning Policy (Major Projects) 2005 development that, in the opinion of the Minister, is development of a kind that is described in Schedule 1 is declared to be a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* (EP &A Act) applies.

This report provides a description of the development proposal, lists relevant planning instruments and provides a general description of the key environmental issues that will be addressed as part of the Environmental Assessment.

2 THE PROPOSAL

2.1 Objectives of the proposal

Wind power is now considered a mature and cost-effective technology to secure environmentally sustainable power generation for the future. The objective of the proposal is to generate emission free renewable energy to be distributed into the National Electricity Network close to existing electricity transmission lines.

More than 80% of Australia's energy currently comes from coal-fired power stations, with less than 10% coming from clean renewable sources. Energy demands in NSW are growing significantly, with demand in the Newcastle – Sydney – Wollongong area alone growing at around 300 megawatts (MW) per year. Increasingly, consumers are seeking electricity generated from renewable sources rather than fossil fuels that contribute to the greenhouse effect. This project will provide a new, clean, renewable source of energy for the State's growing population – meeting the average annual electricity consumption needs of approximately 60,000 dwellings which is equivalent to satisfying the power requirements of a city more than twice the size of Armidale. Wind power does not require water for cooling and therefore significantly reduces the burden on the State's water supply. The project will result in substantial savings in water consumption and reduced pollution by replacing coal and other fossil fuel-fired electricity.

The new Australian Government has set a 20% Renewable Energy Target for Australia to reach by 2020. To achieve this, Federal Labor plans to increase the Mandatory Renewable Energy Target from 30,000 to 45,000 gigawatt hours (GWh) per year. The Ben Lomond Wind Farm will contribute to the Governments vision for the integration of renewable energy in the power generation mix.

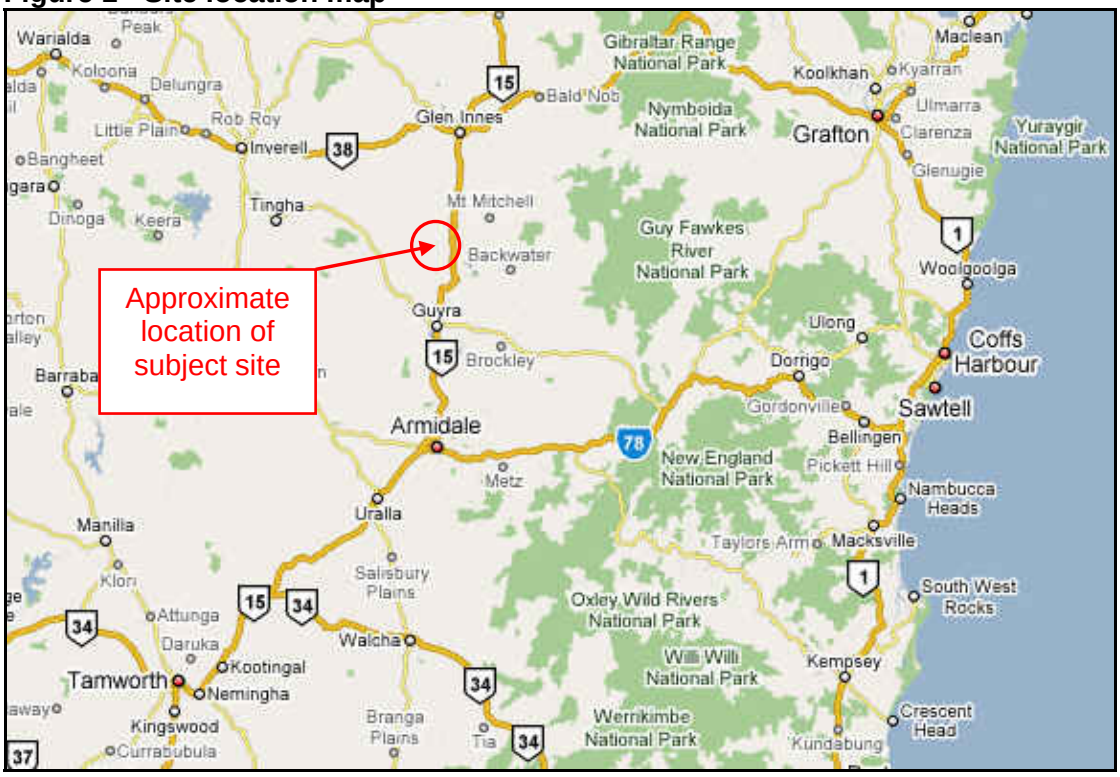
The Ben Lomond Wind Farm will also provide local participating landholders with additional income, which will add to the viability and sustainability of these traditional agricultural landholdings.

2.2 Description of the proposal

The proposed Ben Lomond Wind Farm will have an installed capacity of up to 205MW. The project site is located north of the village of Ben Lomond in the New England Tablelands of northern NSW (see Figure 1). The site is adjacent to the New

England Highway and is situated approximately halfway between the towns of Guyra and Glen Innes.

Figure 1 - Site location map



The proposal includes 98 wind turbine generators connected via underground cables to a substation located in the centre of the site, a facilities building and approximately 8.5km of 132 kilovolt (kV) overhead power line that will connect the substation to the Transgrid 132kV Transmission Line that transects the site east of the New England Highway. Access roads to the turbines will be constructed so as to minimise impacts on the local environment during the construction of the project and to allow ongoing maintenance.

Allco Wind Energy is currently considering two turbine options – Vestas V90/2.0MW and Suzlon S88-2.1MW or similar turbine models. Both turbines are suitable for the wind and terrain conditions observed at Ben Lomond. Alternative turbine models are under consideration which would have an equal or lower environmental impact.

The Vestas V90-2.0 turbine has a nameplate generating capacity of 2,000 kW. The proposed tower height to the hub would be 80m above ground level (AGL), with the height to the blade tip reaching a maximum of 125m AGL. The rotor has 3 blades on the horizontal axis. The diameter of the rotor is 90m and covers a swept area of 6,361m². The Suzlon S88-2.1 turbine has a generating capacity of 2,100 kW. The proposed tower height to the hub would be 80m AGL, with the height to the blade tip reaching a maximum of 124m AGL. The rotor has 3 blades on the horizontal axis. The diameter of the rotor is 88m and covers a swept area of 6,082m².

The 'typical' wind turbine, referred to above, should be regarded as indicative only for the purposes of the Preliminary Assessment with final turbine selection subject to availability and operation & maintenance guarantees. Final turbine design details will be determined prior to the preparation of the Construction Certificate. For the

purpose of the assessment the analysis will be based on an indicative turbine layout consisting of 98 Vestas V90-2.0MW turbines.

Both turbine models are suitable for the wind characteristics of the site and ensure that the rotor gathers the maximum power from the prevailing wind, while minimising loads and controlling output. The turbines will be connected through a 33kV underground cable network to a central substation within the wind farm area. The control cables will also link the turbines to a facilities building which will house an office, electrical and computer equipment, storage and amenities, as well as the main wind farm control room.

The proposed substation will connect to the 132kV transmission line and national grid, which passes through the site, east of the New England Highway. Connection to the 132kV transmission line will require approximately 8.5km of overhead transmission line from the wind farm substation located on the property "Emily Park" to the proposed grid connection point (0377459E, 6680406N – UTM WGS84 56J) subject to reaching an agreement with Transgrid about the point of interconnect. The length of the overhead power line will depend on the final location of the substation within the site and the final location of the point of interconnect.

The access tracks required for the construction and maintenance of the wind farm will be located on private land currently owned by project participants and typically are adjacent to the underground cable network and, where possible, utilise existing farm tracks. Tracks will be graded with road base gravel applied to the 10m wide track to facilitate the high construction loads. Upon completion of construction the access tracks will be returned to 4WD access tracks with a typical width of 4-4.5m.

Each turbine footing will occupy a site of approximately 18m x 18m, however, the ground around each turbine will be rehabilitated following construction to allow agricultural activities to occur up to the base of the turbine tower, leaving an above ground footprint of approximately 16m^2.

2.3 Indicative Site layout plans

Figure 2-1 is a site plan illustrating an indicative layout of the wind farm turbines, cabling, substation, plus the location of the adjacent 132kV Transgrid power transmission easement and an aerial photograph of the site. The site layout will be finalised after the completion of the environmental assessments, identification of any site constraints and an analysis of the optimal layout that considers any site constraints and wind characteristics.

LEGEND

- Wind Farm Site Boundary
- Internal Property Boundary
- Proposed Turbine
- Proposed Track
- 132kv power transmission easement
- New England Highway

To Glen Innes

Smithston

Munsies

Glencoe

Village of Glencoe

Crosby

Yolanda

Beulah

Silent Grove

Banoole

Moorehead

Kanes

Emily Park

Highfields

Mt Emby

Banoole

Tarloon

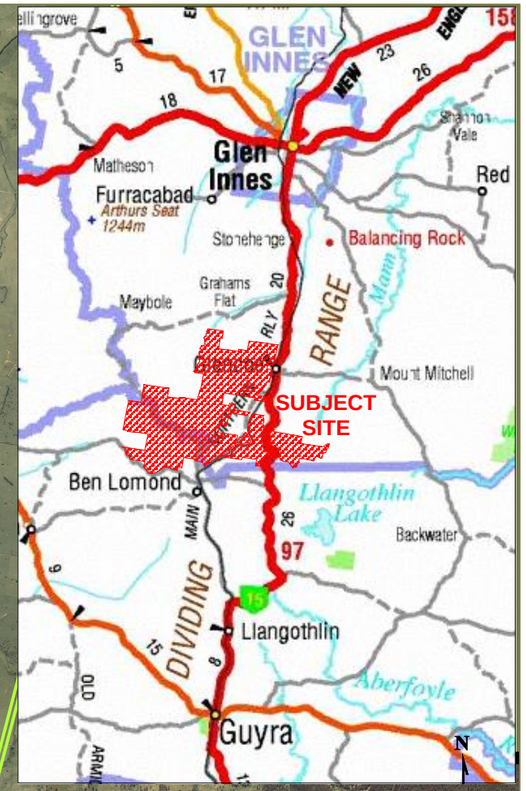
Kenlossie

To Village of Ben Lomond 1km south

To Guyra

ENGLAND HIGHWAY NEW

0 1.5 3 kilometres



TITLE: **FIGURE 2 - 1**
INDICATIVE SITE LAYOUT

CLIENT: Allco Wind Energy

PLANNING SURVEYING ECOLOGY

HARPER SOMERS O'SULLIVAN

SCALE: 1: 56000 at A3 Size **DRAWN:** L. Steel **APPROVED:** S. McCall

DATUM: AMG Zone 56 (AGD 66) **DATE:** 17/1/2008

LAYOUT REF: J:\24k\24861\Drafting\MapInfo\Planning\Prelim EA

CONTOUR INTERVAL: N/A

JOB REF: 24861

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3 SITE DESCRIPTION AND LOCALITY INFORMATION

The following points outline a description of the site and surrounding area:

- **Locality** – Ben Lomond / Glencoe, New England Tablelands.
- **LGA –** The Ben Lomond Wind Farm is to be located predominantly within the Guyra Shire. Part of the Wind Farm will also be located within surrounding districts of Glen Innes Severn Shire and borders the boundary of Inverell Shire.
- **Study Area –** 9,990 ha (13 privately owned rural landholdings)
- **Zoning –** Rural 1(a)
- **Current Land Use –** Cattle and sheep grazing, agricultural production, rural dwellings.
- **Topography –** The site lies on the Great Dividing Range (New England Range) with height ranges of 1,160 – 1,450 metres AHD.
- **Geology –** Geology consists of tertiary basalts on the plateau centred on Guyra and Ben Lomond.
- **Soils –** Chocolate soils and krasnozems on ridges and weisenbodens in valleys.
- **Vegetation –** Mainly cleared, although remnant patches of tall open forests and open forests composed of Ribbon Gum, Snow Gum, Black Sallee, and Mountain Gum on basalt plateaux.
- **Hydrology –** The site sits atop the Great Dividing Range with most of the site draining west into MacIntyre and Severn Rivers (eventually ending up in the Darling River). The eastern portions near Glencoe drain east into the Mann River (eventually ending up in the Clarence River). First and second order streams, including Grahams Valley Creek and Clerks Creek Hydrology, dominate the hydrology. Numerous farm dams occur throughout.

4 STATUTORY CONTEXT AND PLANNING INSTRUMENTS

4.1 Introduction

The site is located across the boundaries of the Guyra and Glen Innes Severn Local Government Areas. The proposed wind farm requires development consent under Part 3A of the *Environmental Planning and Assessment Act 1979* (*EP&A Act*). Under State Environmental Planning Policy (Major Projects) 2005 development that, in the opinion of the Minister, is development of a kind that is described in Schedule 1 is declared to be a project to which Part 3A of the Act applies. On the 2nd January 2008 the Director-General of the Department of Planning, as delegate of the Minister for Planning, formed the opinion that the proposed wind farm is a Major Project to which Part 3A of the Act applies.

4.2 State Environmental Planning Policy (Major Projects) 2005

The project capital value is approximately $300,000,000. The capital value by virtue meets the criteria listed in Schedule 1 Part 3A projects-classes of development, Group 8 Transport, Communications, Energy and Water Infrastructure. Clause 24 – Generation of electricity of heat or co-generation, incorporates development for the purpose of a facility for the generation of electricity that has a capital investment value of more than $30 million. The Minister for the Department of Planning is the approval authority.

4.3 Threatened Species Conservation Act 1995 & Environment Protection and Biodiversity Conservation Act 1999

Pursuant to the *EP&A Act 1979*, developments requiring approval from a Council or a NSW statutory authority are required to be assessed in accordance with the *Threatened Species Conservation Act 1995* (*TSC Act*). The Flora and Fauna Assessment to be undertaken will investigate and assess the potential impacts of the proposal and address the requirements under the *TSC Act* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*). Previous studies have identified a list of those threatened flora / fauna / fish species, endangered populations and endangered ecological communities that have the potential to be found on site or within the region (as listed under the *TSC Act* and the *EPBC Act*.

Previous Flora and Fauna investigations for parts of the site have confirmed that five (5) threatened flora species have been previously recorded within 10km of the site, these being *Dichanthium setosum* (Bluegrass), *Eucalyptus camphora* ssp. *relicta* (Warra Broad-leaved Sally), *Eucalyptus mckieana* (McKie's Stringybark), *Eucalyptus nicholii* (Narrow-leaved Black Peppermint), and *Thesium australe* (Austral Toadflax).

Three (3) threatened fauna species have been recorded on the site or in the immediate vicinity, namely *Neophema pulchella* (Turquoise Parrot), *Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat) and *Miniopterus schreibersii* (Eastern Bent-wing Bat). Three (3) other threatened fauna species has been recorded within 10km of the site, these being *Litoria castanea* (Yellow-spotted Tree Frog), *Phascolarctos cinereus* (Koala) and *Petrogale penicillata* (Brush-tailed Rock Wallaby).

The majority of vegetation within the study area consists of the preliminarily listed endangered ecological community - "Ribbon Gum - Mountain Gum - Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion".

Given that a number of the factors regarding the ecological impacts of wind turbines are poorly understood, a precautionary approach will be taken for the threatened species assessment. Accordingly, even those species considered to have a low / moderate level of potential impact will be subject to an impact assessment as part of the ecological assessment for the proposal.

4.4 Guyra Local Environmental Plan 1988

Under the provisions of the Guyra Local Environmental Plan 1988 (Guyra LEP) the subject land is zoned 1(a) – Rural (General) Zone. Limited agriculture and forestry are permissible without consent under Zone 1(a). Wind farms are not specifically defined in the Guyra LEP and are not listed as prohibited development for any of the rural zones pursuant to the Guyra LEP.

4.5 Severn Local Environmental Plan 2002

Under the provisions of the Severn Local Environmental Plan 2002 (Severn LEP) the subject land is zoned 1(a) – Rural (General) Zone. Limited agriculture and forestry are permissible without consent under Zone 1(a). Wind farms are permissible within in the Rural Zone 1(a) with consent.

4.6 State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP 44 – Koala Habitat Protection encourages the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range. Guyra and Glen Innes Local Government Areas (LGAs) are listed under Schedule 1 of SEPP 44; therefore, the policy is applicable to the site. The Flora and Fauna Assessment will address the requirements under SEPP 44.

5 THE ENVIRONMENTAL ISSUES

5.1 Landscape and visual issues

Wind Farms are dominant structures, particularly when located in rural areas. To assess the impact the proposal will have on the visual landscape, a visual impact assessment is currently being undertaken. The assessment of the visual impact of the wind farm will involve consideration of the visual or scenic quality and visual sensitivity of the area. The assessment will include a discussion on how the landscape and visual impacts have been considered in the design and layout of the turbines and consideration of the landscape values of the affected areas, their importance and sensitivity and their ability to accept change. The wind farm is located between the villages of Ben Lomond and Glencoe and the visual assessment will include investigations into any potential visual impacts on these villages associated with the wind farm.

The existing character of the area between Guyra and Glen Innes and the wider region may be described as undulating, moderately sloped rolling hills with shallow valleys in between, typical of the district. No significant ridgelines dominate the landscape. Patches of remnant vegetation remain across the precinct with remaining areas dominated by grass cover. No dominant permanent water sources are visible from public viewing areas within the visual catchment.

The visual catchment has a number of distinctive existing anthropogenic structures located within the landscape. These include the villages of Glencoe and Ben Lomond, 132kV and 66kV transmission line towers, communication towers, the old New England Railway line, the New England Highway and other existing road networks. The visual catchment beyond the site consists of undulating hills and

valleys. Farm residences plus farm associated sheds and structures are scattered through the landscape. Consideration will be given to the impacts on the visual amenity of existing and approved residences and road users, including potential impacts of blade flicker and glint, with particular emphasis on receivers within 2km of the turbines.

A series of photomontages from strategic vantage points, both public and private will also be produced to illustrate the turbines within the landscape.

5.2 Shadow flicker

Shadow flicker is a term used to describe the change in light intensity observed when a wind turbine blade casts an intermittent shadow upon a receptor. The number of hours of theoretical shadow flicker can be determined by considering potential receptors (homes) in relation to wind turbines and sun position. A limitation of the shadow flicker modelling is that it does not account for existing vegetation or structures. A Shadow Flicker Study will be undertaken for the site.

5.3 Noise issues

Turbines produce mechanical, electrical and aerodynamic noise. An assessment of the operational noise of the turbines for the proposal will be prepared. The assessment methodology will be in accordance with the *Environmental Noise Guidelines – Wind Farms,* as published by the Environmental Protection Authority of South Australia (EPA SA Noise Guidelines). These guidelines have been used for the assessment of wind farm noise in SA, Vic, NSW and are listed in the draft guidelines for the development of wind farms produced by NSW Planning.

As defined by the NSW Planning Guidelines and set out in the SA EPA Guidelines which were adapted by the Government of NSW for the assessment of wind farm projects, a noise limit of 35 dB(A) or background noise + 5 dB(A) whichever is greater at receivers in the vicinity of the wind farm is considered appropriate for wind farm noise assessments. In addition, conservative estimates of the variation in background noise level with changes in wind speed, based on local measurements, will be used to determine the appropriate adjusted noise limit at residences. These background noise levels are currently being recorded according to the SA EPA Guidelines at three strategic locations alongside the project site boundary.

In the case where a significant level of annoyance or disturbance due to wind farm noise is experienced by a resident, and the limits presented by the SA EPA Guidelines are found to be exceeded during operation of the wind farm, noise mitigation measures will be investigated by the operator of the wind farm.

5.4 Traffic and Access

A Traffic and Transport Study for the project is currently being prepared. The study will assess the traffic impacts the proposal may place upon the villages of Ben Lomond and Glencoe and also Guyra Shire and Glen Innes Severn Shire road networks. The likely transport routes chosen to ship the turbines and associated componentary to the site will also be assessed. Particular emphasis will be given to construction traffic management issues and the assessment will detail possible mitigation measures to reduce any impacts.

5.5 Communication issues

Wind turbines have the potential to interfere with radio, television, and microwave transmissions. Electromagnetic Interference (EMI) is a term used to define the potential impact of rotating metallic structures and conductible surfaces. An EMI assessment will be undertaken to determine if the project will impact upon communications within the area. A detailed analysis of the transmitter/receiver towers that may be impacted by the proposal will be included in the assessment. Should EMI be identified as an operating issue, mitigative measures such as installing repeater transmitters at affected locations will be adopted.

5.6 Drainage issues

Drainage impacts on the environment will be mitigated through the implementation of the erosion and sediment control measures that will be incorporated into the Construction and Operational Environmental Management Plans.

5.7 Flora and fauna issues

Parsons Brinckerhoff (PB) undertook initial ecological surveys for the project between the 15th and 19th March 2004. These initial surveys were undertaken over a different layout and only included the southern half of the study area. Subsequent surveys over the northern part of the study area and project layout were undertaken by HSO between the 7th – 11th March 2005 and 25th – 27th May 2005. The entire project area and final turbine locations will be reassessed as part of the ecological investigations for the Ben Lomond Wind Farm.

From the information presented in previous studies it is asserted that no significant impacts are expected to threatened flora and fauna species listed under NSW *TSC Act*. No significant impacts are expected to any matters of national environmental significance (NES), as listed under the Commonwealth *EPBC Act*. The previous wind farm project for 64 turbines was referred to the Department of Environment and Heritage (DEH) (Ref No: EPBC 2005/2215) and on the 17th August 2005, a determination was made that the proposal is not a controlled action.

As a positive environmental consequence, the proposal will address (in-part) the key threatening processes of “human-caused climate change” (as listed under the *TSC Act*), and “loss of climatic habitat caused by anthropogenic emissions of greenhouse gases” (as listed under the *EPBC Act*).

Some minor impacts to birds and bats may be expected due to turbine collisions. These are likely to be inline with or less than stated AusWEA (2004) collision rates of several individuals per turbine per year, though this will be reassessed as part of the ecological assessment. Some minor changes to the local distribution and abundance of locally occurring common species may also be expected as a consequence of the ongoing operation of the turbines.

Whilst some minor impacts to individual birds and bats may be expected as a consequence of the project, these impacts should be viewed in light of the growing body of scientific evidence which highlights the potentially drastic environmental consequences (including loss of species and ecosystems) from a continued dependence on traditional energy sources that produce greenhouse gas emissions, such as coal-fired power stations (eg. AGO 2003). Wind energy’s ability to generate electricity without many of the environmental impacts associated with other energy sources (eg. air and water pollution and greenhouse gas emissions) can significantly

benefit birds, bats, and many other flora and fauna species (NWCC 2004), including those species / communities on the New England Tablelands bioregion that are currently threatened by climate change.

5.8 Heritage issues

A previous Heritage Assessment for part of the project area has been undertaken and concluded that it is unlikely that the project will impact on items of Aboriginal cultural heritage as the fieldwork and background reading has shown that the relative frequency of artefact occurrence is likely to be very low. However, a full archaeological survey and assessment will be undertaken to ensure that all Aboriginal and European Heritage matters are investigated and assessed.

5.9 Socio-Economic issues

The project will have significant social and economic benefits for the local area and the wider community plus some associated localised negative impacts. The wind farm will result in a major investment in the area, which will require the employment of local labour and resources. Construction of the wind farm will provide both direct and indirect benefits by increasing the economic opportunities available to the local and wider community.

The wind farm will provide potential tourism opportunities, which also has flow on effects that extend to other ancillary service sectors such as accommodation, fuel suppliers and food outlets. The 'green tourism' sector is a growing market in Australia as more people become aware of greenhouse gas issues and climate change concerns. These same issues and the development of the wind farm could provide educational opportunities for local schools, where students could visit the wind farm and view renewable energy production in action.

Wind farms provide interesting architectural elements within the landscape that are still rare in most areas of Australia. Individual perception of the turbine architecture and its impact within the landscape is highly subjective. Initial community consultation for the previous wind farm development has demonstrated a good level of community support. Further community and key stakeholder consultation will be undertaken as part of the project development phase and during the subsequent stages of the wind farm. A consultation report outlining the community, stakeholder and government agency consultation will be prepared as part of the Environmental Assessment.

5.10 Aviation issues

Under Civil Aviation Safety Regulations Civil Aviation Authority (CASA) Part 139, the Civil Aviation Authority must be notified:

- *By a person who proposes to construct a building or structure the top of which will be 100 metres or more above ground level.*

CASA will be notified of the proposal through the CASA NSW Country Field Office at Canberra. Additionally, CASA must be notified if the wind farm is within the vicinity of an aerodrome (within 15km). No aerodrome has been identified within 15km of the wind farm; however, a number of private landing strips are located in the area.

A lighting plan will be developed in accordance with the Civil Aviation Safety Authority (CASA) Advisory Circular AC 139-18(0) Obstacle Marking and Lighting of Wind Farms (September 2004) and submitted to CASA for approval.

The local aerial contractor will be included in the finalising of turbine locations throughout the process.

5.11 Bushfire Issues

A Bushfire Risk Assessment will be undertaken to determine the potential risk and management issues relating to the proposal. The wind turbines will be located well clear of any significant vegetation. The turbines will be earthed to prevent any arcing of electricity or surges resulting from lightning strikes. The area surrounding the entire wind farm site will be examined and assessed as part of the determination of any potential bushfire risk.

5.12 Safety issues

Wind farm safety issues are predominantly related to turbine construction and maintenance. Safety issues regarding construction, on-going operation and aviation will be investigated.

5.13 Cumulative issues

The placement of a wind farm in any environment will result in a variety of impacts. The assessment of the cumulative impact of the proposed wind farm will balance the various environmental impacts including visual, noise, flora and fauna against the benefits of generating renewable, non polluting electricity for the local population and the wider community.

6 COMPILATION OF MITIGATION MEASURES

Following the specialist environmental assessments, the mitigation measures proposed to ameliorate any potential impacts will be compiled into a draft statement of commitments. The draft statement of commitments will be included in the Environmental Assessment and will outline the commitments the proponent will undertake to mitigate any potential issues associated with the development of the Ben Lomond Wind Farm.

Prior to commencing work, the contractor will be required to prepare a Construction Environmental Management Plan (CEMP) to address Occupational Health & Safety requirements, environmental protection and general risk management issues. The CEMP will specify measures to be adopted by the contractor to minimise interference with and the disturbance of the environment during the construction of the wind farm and associated facilities.

Effective and appropriate management of sediment and erosion created by the construction process will be a feature of this project. The key to effective erosion prevention and sediment control is to minimise the amount of ground disturbance at any one time and to have an effective management approach that incorporates the use of various devices in sequence to manage any runoff created during the construction process.

A comprehensive Operational Environmental Management Plan (OEMP) will be prepared to manage and mitigate impacts associated with the on-going operation of the wind farm. The OEMP will adhere to the philosophy of adaptive management. The philosophy of adaptive management is followed when policies and practices are continually improved by learning from the outcomes of previous work.

7 CONCLUSION

Allco Wind Energy looks forward to establishing an environmentally friendly, viable and sustainable wind farm in the Ben Lomond and Glencoe area, which will provide significant environmental and economic benefits to the local population, the region and the State of NSW. Through consultation with all relevant stakeholders, constant communication with the involved and neighbouring landholders and a design encompassing all aspects of sustainable power generation aiming to adhere to the Australian Wind Energy Association's recently developed Best Practice Guidelines, the proponent believes the wind farm will be a positive example of a renewable energy development.

The Ben Lomond Wind Farm will generate clean, green renewable energy for generating the equivalent electricity consumption of more than 60,000 dwellings per annum. Energy produced by the Ben Lomond Wind Farm will contribute to achieving the reduction of greenhouse gases and further diversify the electricity source for NSW. Being a source of energy without the need for cooling water this wind farm will help to better utilise the very limited water resources in the State.

The Ben Lomond Wind Farm will provide local participating landholders with additional income, which will add to the viability and sustainability of these traditional agricultural landholdings. The project will assist the region to meet environmental objectives and the principles of Ecologically Sustainable Development through the generation of renewable energy, and consequent greenhouse gas abatement. Through local employment and additional business opportunities created by this significant investment Ben Lomond Wind Farm will support the local and regional economy and improve the attractiveness of the New England Region.

APPENDIX A Wind Turbine Product Information

MULTI MEGAWATT

SERIES

SUZLON

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NEW PARADIGM IN
WIND POWER GENERATION

At Suzlon, our ethos is "We are because we innovate." Reinforcing this philosophy is our unflinching commitment to continuously raise the bar to provide technologically superior, more reliable, and efficient wind turbines.

SUZLON MULTI MEGAWATT SERIES

The Suzlon Multi Megawatt series
of high-performance wind turbines is replete
with such innovations

- Higher efficiency
- Reduced stresses
- Better power quality
- Lower operating costs
- Higher reliability
- Better performance
- Increased safety

Increased Return on Investment

Peace of Mind

The unique combination of the digitally synchronised micro pitching and Macro-slip mechanism, light and robust blades manufactured using Resin Infusion Moulding (RIM) technology and the next gen advanced control system result in lifetime returns on investment and absolute peace of mind for our customers.

ROTOR BLADES

The rotor blades are aerodynamically optimized to provide high lifting forces and low air-resistance values. Manufactured using Resin Infusion Moulding (RIM) technology, they are extremely lightweight, and at the same time possess high stiffness and mechanical strength. Their low weight-to-diameter ratio results in lower stresses enhancing the life and efficiency.

Blades are the starting point of the train for power transmission. Hence, even a small increase in blade efficiency is magnified across the power train to give higher efficiencies for the entire machine.

MICRO PITCH SYSTEM

The rotor blades are connected to the hub via pitch ball bearings and can swivel fully perpendicular to the sense of rotation. The motors of the pitching system have an in-built intelligent system, with frequency control drives controlled by their own microprocessor. These intelligent frequency drives talk with the control system in real time, with response time of just 30 ms. The control system updates the motors after gauging the available wind regime, and the motors constantly update the control system on the instant blade angle.

The precision electromechanical micro pitch mechanism achieves 0.1 deg pitching resolution, resulting in extreme fine-tuning of the aerodynamic profile.

MACRO SLIP MECHANISM

The flexible, adjustable slip system used in the Multi Megawatt series offers a maximum slip of as high as 16%, thereby increasing the efficiency of energy conversion by ensuring extremely low loss of power from wind due to gusts and frequent changes in wind speeds.

The robust and compact mechanism ensures that the overall machine reliability is maximised. The system is simple, easy to use and cost effective to service. The main advantage of the system is that it allows the use of standard, conventional generators with proven reliability. The Macro Slip mechanism is finely synchronized with the micro pitching mechanism to give optimum performance. The entire related power electronics is static and does not rotate at high speeds, increasing their reliability and overall life.

Other advantages of the Suzlon Macro Slip system include:

Fail-safe protection against over voltage and over current for the converter and generator in case of line failure

Autonomous adaptive control for maximum slip range

Totally modular system, equipped with robust power electronics

Vector Control for extremely low harmonics with high torque dynamics ability

PERFORMANCE DRIVEN GEARBOX

A multi-stage planetary / spur wheel gearbox ensures highest possible mechanical efficiency and power. The first planetary gear stage takes up the slow rotor movement and distributes the high torque input to subsequent planetary gears.

The highest levels of manufacturing accuracy and FEM calculation of the planet carrier ensure optimal load distribution to the planet gears. Reduced torque values and increased rotational speeds are optimally converted to the high-speed operation of the generator.

A permanent, mechanically driven oil-pump supplies the gearbox and main shaft bearings with pressure lubrication, which is in addition to the splash lubrication.

The micro-filter system retains the quality of the oil and assures an extended service-interval. The oil-cooling device renders temperature optimization even under full load operation.

ASYNCHRONOUS GENERATOR

A 4-pole, single-winding, asynchronous slip ring type generator with highly adaptable and flexible “Macro Slip” mechanism translates into high efficiency values.

The exceptionally high slippage is achieved by varying the resistance on the rotor windings dynamically. The resistors are connected to the rotor windings via a slip ring mechanism making them static and mountable outside the generator cage. Externally mounted resistors provide excellent heat dissipation and the resistors do not rotate at the high speed of the rotor, which results in a longer service life.

These generators are robust and have a proven track record of decades in operation. The moisture-repellant insulation in high class F configuration combined with a forced surface air-cooling system guarantees total protection from moisture and dust.

A welded squirrel cage, vibration resistant windings and a re-greasing device with grease collecting chamber, result in increased service-life and longer maintenance intervals.

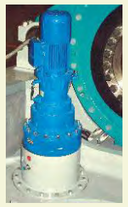
YAW SYSTEM

A braking torque adjustable polyamide slide bearing transmits the loads from the nacelle to the tower through an expansive surface.

The yawing movement is activated and controlled by 3 electrically braked gear motors.

Precise wind direction measurement and an advanced statistics analyzing software ensure an exact alignment of the rotor to the wind, thereby reducing energy losses and additional loads caused by oblique incident flows.

A cable twist sensor in the Yaw System monitors over-twisting of cables due to constant wind direction changes and alerts the controller to untwist the cables.



ADVANCED DIGITAL CONTROL SYSTEM

The advanced control system has been developed in close association with the world leaders in the field who have rich experience of over 5000 wind turbines worldwide. The system provides excellent safety & reliability, while generating optimal energy output.

The control system is scalable in nature with standard interface options including RS232/422/485, Ethernet, Fibre optic link, CAN Bus, networking, etc. The option for web-enabled communication is also available. The entire control system is modular and offers a high degree of customization.

The Grid connection module is designed for soft connection to the grid. With COS PHI circuitry, it ensures effective current control at all times, viz. before, during and after the synchronous point. The Pitch module has its own microprocessor to do pitch calculations. Various safety modules for rotor revolution, vibration, etc. ensure safe and reliable running of our turbines. The control systems have condition-monitoring feature to help monitor the health of the turbine for any predictive and preventive maintenance.

The graphical display unit shows all there is to know about the performance and the state of various parameters at a touch of a button. Remote monitoring and control option have various combinations which can be customised as per the client's needs.

The system has been designed to perform in tough environmental conditions, and can withstand shock, vibration and temperatures ranging from arctic cold to hot and humid tropicals.

HEAVY-DUTY CAST HUB

The hub is manufactured with high quality GGG 40.3 casting. The design has been optimized after a series of load simulation tests for fatigue and extreme load conditions. This combined with a detailed FEA analysis and the experience we have gained in running over 1000 machines worldwide, has resulted in excellent mechanical properties.

The design also provides high reliability by eliminating alignment problems - the leading cause of unwanted loads and stresses. The integral design, tested with customized NDT and quality checks, assures highest levels of reliability.

FAIL-SAFE MECHANICAL BRAKING SYSTEM

In addition to the aerodynamic braking system, Suzlon Multi Megawatt Series is equipped with mechanical braking to stop the wind turbine in case of an emergency.

The disc brake is configured to be fail-safe. It is activated by spring forces and released hydraulically.

This combination of aerodynamic and mechanical systems, allows for complete load control during braking processes and maximum load reduction in any operational case, ensuring utmost safety to the wind turbine even in case of an emergency.

HIGH-EFFICIENCY HYDRAULIC SYSTEM

A high-quality hydraulic system, similar to the one found in jet planes, supports the mechanical braking devices.

A motor and pump assembly draws oil from a reservoir and pushes it via high-efficiency filters through the system to ensure that the hydraulic oil remains clean during the extended service interval.

TOWER & NACELLE

Specially Designed Tower

Suzlon Multi Megawatt Series comes with an option of tubular or lattice tower. Stiffness of both these designs eliminates critical natural frequencies of the tower. This design reduces the dynamic stressing of the tower and the entire wind turbine to a minimum.

A high-quality corrosion protection system comprising of several layers of either epoxy coat (in case of tubular towers) or hot dip galvanization (in case of lattice towers), protects the structure and increases its service life.

NDT, including ultrasonic and X-ray tests are integral to the advanced quality management system. The climbing guard system meets the requirements of international safety supervisory authorities.

Weather-resistant Nacelle Cover

The nacelle cover is made of fiber-reinforced plastic and designed in such a way that the internal components are fully protected against various ambient conditions. It also ensures adequate noise dampening.

back to index

MULTI MEGAWATT

TECHNICAL SPECIFICATIONS

SUZLON

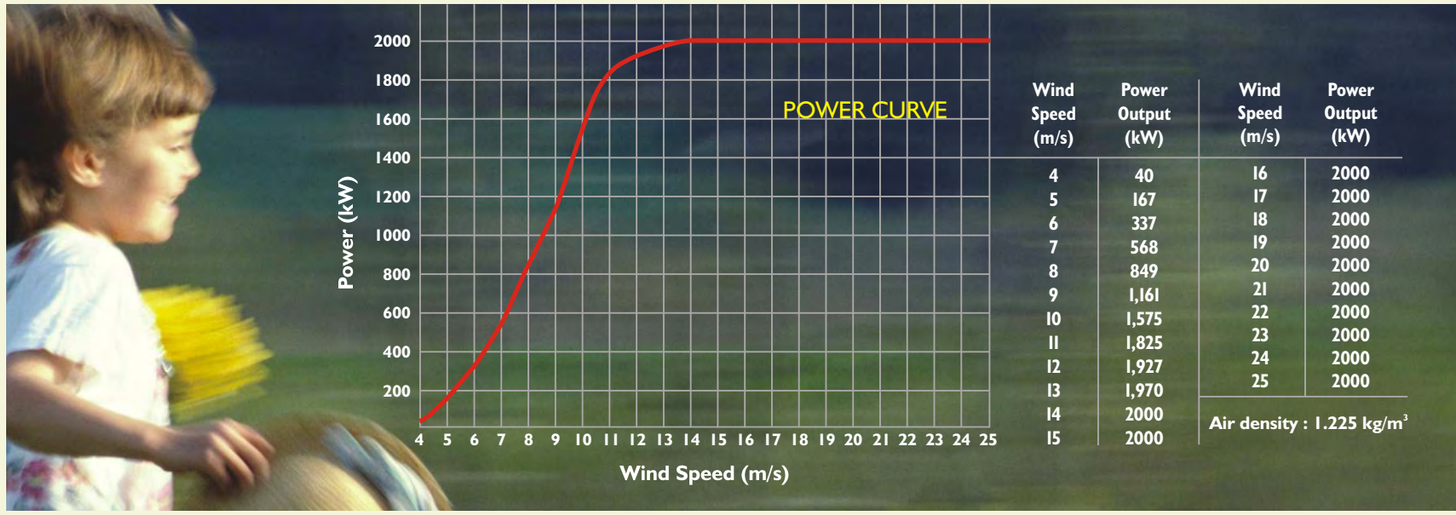
www.suzlon.com

At Suzlon, our ethos is "We are because we innovate."

Reinforcing this philosophy is our unflinching commitment to continuously raise the bar – to provide technologically superior, more reliable, and efficient wind turbines.

The Suzlon Multi Megawatt series of high-performance windmills is replete with such innovations:

- **Unique Micro Pitch System**
  Unparalleled full span pitching from -5 to 88° with resolution of 0.1° results in maximum power harnessing and minimal losses. The system includes smart logic automated pitching and independent electromechanical pitch control for each blade.
- **Unmatched Macro Slip Mechanism**
  This pioneering flexible mechanism absorbs noise and helps produce clean power with a power factor of up to 0.99, even in high turbulence wind regimes. The Suzlon Megawatt Series windmill has raised the benchmark for the maximum slippage attained to 16% - the highest in its class.
- **State-of-the-art Manufacturing Technology**
  Manufactured using the advanced Vacuum Assisted Resin Infusion Moulding (RIM), the rotor blades have a low weight-to-sweep ratio ensuring higher energy outputs at lower costs. The RIM technique results in a homogeneous structure which is light on weight and high on strength.
- **Advanced Control System**
  Precisely calibrated sensors installed at each critical junction closely monitor factors like temperature, wind speeds, vibrations etc. The remote monitoring and control option enhances ease of operation.
- **High-quality Power Generation**
  Suzlon turbines are soft and friendly towards the utility grid. Each component, from the blade to the grid, is designed to generate high quality, harmonics free, and grid-friendly power.
- **Well-balanced Design**
  The wind turbines are designed to withstand the toughest environmental conditions. The robust design of the windmill, with its uniform weight distribution, ensures high levels of safety, reliability and enhanced service life.



Wind Speed (m/s)	Power Output (kW)	Wind Speed (m/s)	Power Output (kW)
4	40	16	2000
5	167	17	2000
6	337	18	2000
7	568	19	2000
8	849	20	2000
9	1,161	21	2000
10	1,575	22	2000
11	1,825	23	2000
12	1,927	24	2000
13	1,970	25	2000
14	2000		
15	2000		

Air density : 1.225 kg/m³

These innovative features culminate in numerous tangible benefits for our customers:

Higher efficiency / performance

Reduced stresses and loads

Better power quality

Increased safety

Prolonged life / durability

Higher reliability

Lower operative cost

Increased ROI

Peace of mind

MODEL: S.88/2000

Operating Data

Installed elec. output	2 MW
Cut-in wind speed	4 m/s
Rated wind speed	14 m/s
Cut-out wind speed	25 m/s
Survival wind speed	67 m/s
Hub height	80 m*

Generator

Type	Asynchronous 4 poles with slip ring
Rated power	2000 kW
Rated voltage	690 V / 600 V
Rotational speed	1511 / 1812 rpm
Frequency	50 Hz / 60 Hz
Protection	IP54
Cooling system	Air cooled
Insulation	Class F
Slip control	Unique Macro slip providing slip upto 16.67%

**Hub height is variable as per requirements of the site*

Rotor

Type	3 bladed, horizontal axis
Diameter	88 m
Swept area	6082 m^2

Braking System

Aerodynamic braking	3 independent systems with blade pitching
Mechanical braking	Hydraulic disc brake

Yaw System

Type	Active electrical
Bearing	Polyamide slide

Gearbox

Type	3 stage
Ratio	98.828:1 / 118.050:1
Nominal load	2200 kW

Certifications

Design standards	GL / IEC
Quality	ISO 9001

Germanischer Lloyd WindEnergie GmbH ISO 9001

Due to constant upgradation specifications are subject to change without prior intimation

back to index

V90-1.8 MW
V90-2.0 MW

Built on experience

Vestas®

No. 1 in Modern Energy

Innovations in blade technology

Optimal efficiency

The OptiSpeed®* generators in the V90-1.8 MW and the V90-2.0 MW have been adapted from those in Vestas' highly successful V80 turbine. OptiSpeed® represents a significant advance in wind turbine efficiency as it allows the rotor speed to vary within a range of approximately 60 per cent in relation to nominal rpm. This means that with OptiSpeed®, the rotor speed can vary by as much as 30 per cent above and below synchronous speed. Its purpose is simple: to maximise energy output.

It does this by tapping the higher efficiency of slow and variable rotation, storing excess energy in rotational form and exploiting the full force of transient gusts. All told, OptiSpeed® boosts annual energy production.

As an added benefit, OptiSpeed® also reduces wear and tear on the gearbox, blades and tower on account of lower peak loading. Moreover, as turbine noise is a function of wind speed, the lower rotation speeds made possible by OptiSpeed® naturally reduce sound levels.

Finally, OptiSpeed® helps our V90s deliver better quality power to the grid, with rapid synchronisation, reduced harmonic distortion and less flicker.

3×44 metres of leading edge

Vestas blades have always been among the lightest on the market, and with the V90 turbines, we have once again raised the bar. The new blades feature several new light-weight materials, most notably carbon fibre for the load-bearing spars. Not only is carbon fibre lighter than the fibre-glass used in previous blades, but its strength and rigidity have also made it possible to reduce the amount of material required. This means that even though our V90s have 27 per cent more swept area than our V80s, the longer blades actually weigh about the same.

The V90 blades also have a new profile that is aerodynamically superior to the previous generation. Vestas engineers developed this technologically advanced profile by optimising the relationship between the overall load impact on the turbine and the power generated annually. The fruit of their labours was an entirely new plane shape and a curved back edge.

The resulting airfoil improves energy production, while making the blade profile less sensitive to dirt on its leading edge and maintaining a favourable geometrical relationship between successive airfoil thicknesses. For the V90 turbine, this translates into an increase in output combined with a decrease in load transfers - as well as improvements on the bottom line.

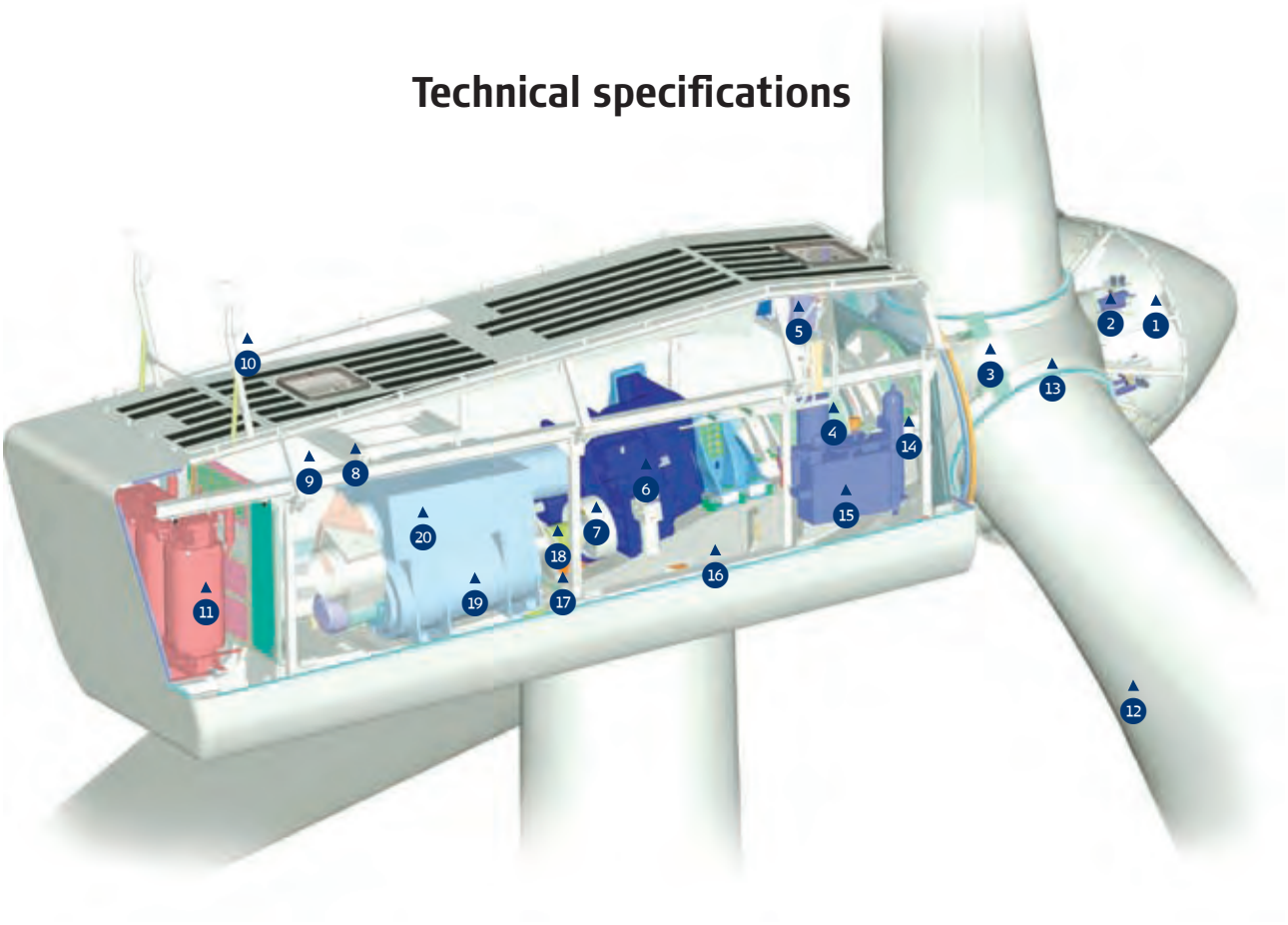
Proven Performance

Wind power plants require substantial investments, and the process can be very complex. To assist in the evaluation and purchasing process, Vestas has identified factors that are critical to wind turbine quality: energy production, power quality and sound level..

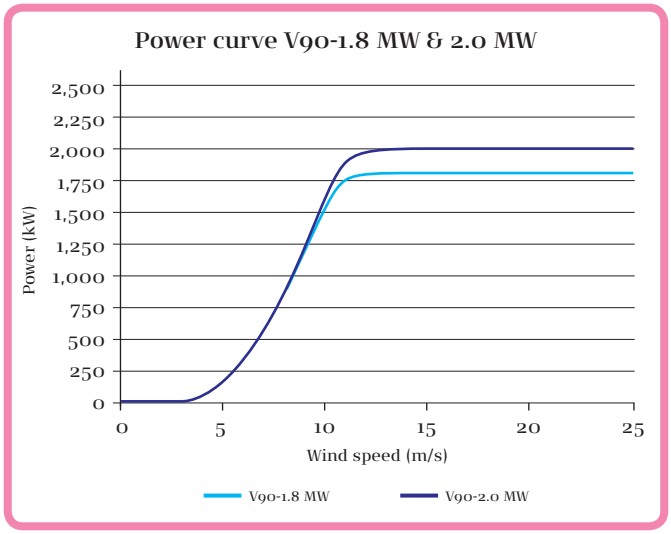
We spend months testing and documenting these performance areas for all Vestas turbines. When we are finally satisfied, we ask an independent testing organisation to verify the results - a practice we call Proven Performance. At Vestas we do not just talk about quality. We prove it.

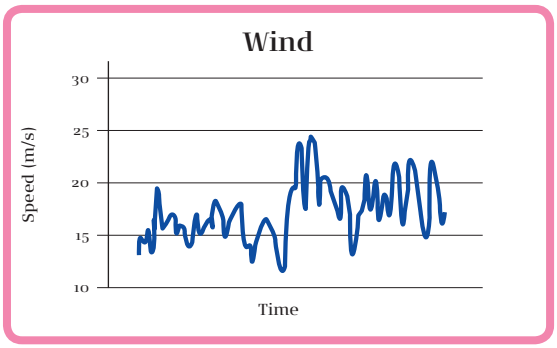
** Vestas OptiSpeed® is not available in the USA and Canada*

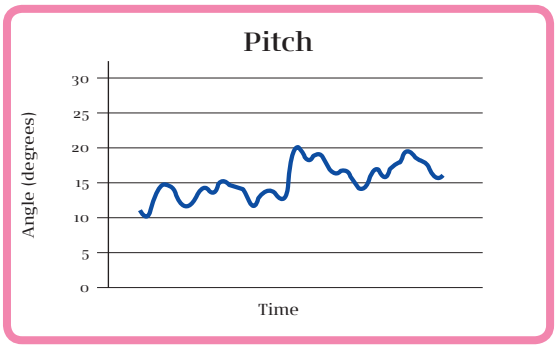
Technical specifications

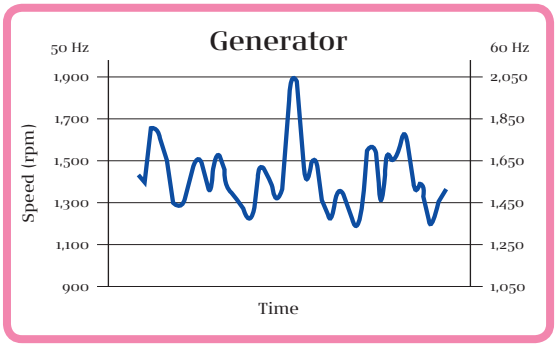


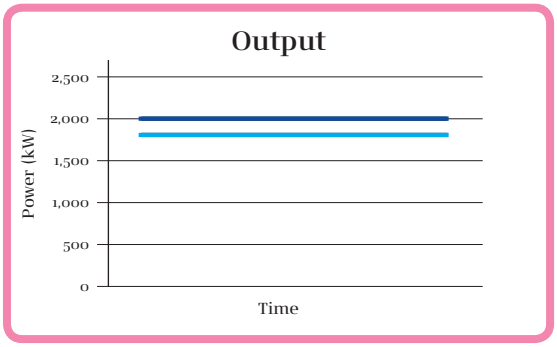
1 Hub controller
2 Pitch cylinders
3 Blade hub
4 Main shaft
5 Oil cooler
6 Gearbox
7 Mechanical disc brake
8 Service crane
9 VMP-Top controller with converter
10 Ultrasonic wind sensors
11 High voltage transformer
12 Blade
13 Blade bearing
14 Rotor lock system
15 Hydraulic unit
16 Machine foundation
17 Yaw gears
18 Composite disc coupling
19 OptiSpeed® generator
20 Air cooler for generator











OptiSpeed® allows the rotor speed to vary within a range of approximately 60 per cent in relation to nominal rpm. Thus with OptiSpeed®, the rotor speed can vary by as much as 30 per cent above and below synchronous speed. This minimises both unwanted fluctuations in the output to the grid supply and the loads on the vital parts of the construction.

Rotor

Diameter:	90 m
Area swept:	6,362 m²
Nominal revolutions:	14.9 rpm
Operational interval:	9.0-14.9 rpm
Number of blades:	3
Power regulation:	Pitch/Optispeed
Air brake:	Full blade pitch by three separate hydraulic pitch cylinders

Tower

Hub height:	80 m, 95 m, 105 m

Operational data

	IEC IIA:	IEC IIIA/DIBt II:
	1,800 kW	2,000 kW
Cut- in wind speed:	3.5 m/s	2.5 m/s
Nominal wind speed:	12 m/s	13 m/s
Cut-out wind speed:	25 m/s	25 m/s / 21 m/s

Generator

	IEC IIA:	IEC IIIA/DIBt II:
Type:	Asynchronous with Optispeed	Asynchronous with Optispeed
Nominal output:	1,800 kW	2,000 kW
Operational data:	50 Hz/60 Hz 690 V	50 Hz/60 Hz 690 V

Gearbox

Type:	Planetary/helical stages

Control

Type:	Microprocessor-based control of all the turbine functions with the option of remote monitoring. Output regulation and optimisation via OptiSpeed and OptiTip pitch regulation.

Weight

Nacelle:	68 t
Rotor:	38 t

Towers:

Hub height:	IEC IIA	IEC IIIA	DIBt II
80 m	150 t	150 t	-
95 m	200 t	-	200 t
105 m	-	-	225 t

t = metric tonnes

DIBt towers are only approved for Germany.

All specifications subject to change without notice.

Built on experience

State-of-the-art wind turbines are not developed in a vacuum. To create the new V90-1.8 MW and V90-2.0 MW turbines for low and medium wind, we have drawn on the vast experience gained as the leading supplier of wind energy systems in the world. In particular, we applied successful design elements from our existing range of turbines.

We began with the nacelles of our tried and tested V80 wind turbines, which feature OptiSpeed® generators for maximum productivity. To these, we fitted the revolutionary new blades from our high-wind V90-3.0 MW. We then modified the components to ensure optimal harmonisation and to make the very most of the target conditions.

The resulting V90-1.8/2.0 MW turbines are optimised for sites with low turrbulence and low and medium winds. These innovative wind turbines are so successful that they can actually geneerate 25 per cent more energy than the corresponding V80s.

Naturally, the new integrated turbines feature innovations of their own innovations. For instance, Vestas engineers spent two years designing a more efficient and more robust gearbox. Moreover, while the 90-metre rotor weighs approximately the same as the V80 rotor, the longer blades mean higher loads, so we also reinforced the transmission and other major components of the V90.

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09/07 UK